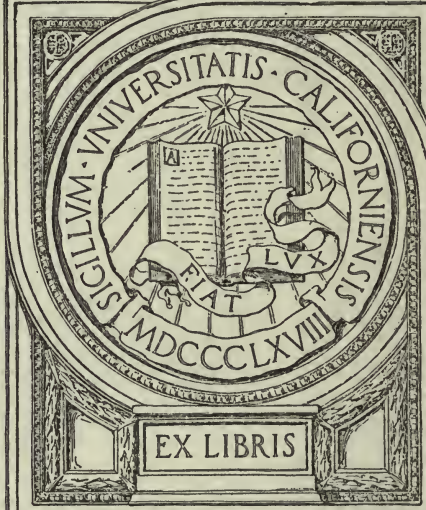
ELEMENTARY EXERCISES IN AGRICULTURE

DADISMAN



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ELEMENTARY EXERCISES IN AGRICULTURE

BY

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PREFACE

For a long time the author has felt the need of a book to put in the hands of the rural teacher as a guide in showing the children the real value of agricultural work in the laboratory. The true teacher feels that all the explanation needed should be given and no more. It should be given in a plain, clear-cut way. The teacher can take this book and use it even if she has not had any work on agriculture. The equipment is simple, so simple that any country school can get it. The things that are used are also practical.

This book aims to tell of the things that the child should know in order to become interested in the farm life. The school work is made significant by having the children actually doing the things themselves. The farmer demands that his boy should know how to do things, and there is no better place than the laboratory to do many of the things the child needs to be taught. It is to provide for the doing of these things that this little book is written.

The author will be glad to correspond with teachers concerning any difficulties in the work, and will

be glad to receive suggestions as to ways in which it may be improved.

The equipment is so simple that it is not necessary to describe it. A pair of small spring balances, some pans, bottles, boxes for soil. The children can get almost everything else except the few chemicals that can be gotten at the drug store immediately before they are to be used.

Thanks are due to Messrs. Roe Peterson and Company for the use of the cuts from Noloni's "One Hundred Lessons in Agriculture," Nos. 3, 6, 7, 8, 15, 19, 24, 25, 27, 28, 29, 30, 31, 32, 33, 35, 36, 40, 14, 42; United States Bulletin, No. 239, for 2, 4, 5; B. F. Johnson Publishing Company, for 26, 27; The Macmillan Company, for 34; M. V. Slingerland, for 45, 46; C. R. Crosby, *Country Gentleman*, for 16. Acknowledgment is also made to Mr. A. J. Dadisman for his help on the book.

S. H. DADISMAN.

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ELEMENTARY EXERCISES IN AGRICULTURE

SOIL

Exercise I[1]

Object. To become familiar with the kinds of soil.

Method. Use a sample of the four typical kinds of soil: clay, sand, loam, and peat. These samples may be gathered by the class the day before the experiment is to be worked out. Place them side by side in plates or glasses where the children may examine them. All the lumps should be broken up until the soil will go through a fine sieve.

Examine each sample of soil as to fineness and color. Rub the particles between the thumb and finger. Which kind of soil seems to be the finest? Which is the coarsest?

Wet a handful of each kind of soil. Mix and squeeze each kind in the hand. Which then crumbles and falls apart easily? Which is the most sticky?

Take four tumblers each half full of water. Put a small quantity of one kind of soil in one glass. Put the same quantity of another kind in the next glass.

[1] Each child should have a notebook and write up each experiment as soon as it is finished.

Put a different kind of soil in each glass. Stir the water and the soil in each glass and then notice which settles first. Shake again and after a minute pour off the water from one of the glasses. Does the water poured off look like sand? Can you give any reason for this?

What happens to the fine particles of earth in the glass when the earth is stirred?

Write a full description of each soil.

Exercise II

Object. To determine the amount of moisture in the soil.

Method. Get a quart of soil from the plowed ground just after a heavy rain. Weigh it and record the weight. Then heat it on a hot stove until it is dry. Weigh it again after heating. Compare the weight. The difference in the two weights is the weight of the water that was in the soil. In this way find the amount of water that is contained in the different soils. Compare these amounts. Explain then how some soils can do without water longer than others.

In dry weather get a quart of soil from just under the sod and weigh it. Then dry it thoroughly and weigh it again. Does it have more water in it in dry weather than the barren soil? What effect do you think this would have on the crop?

Would a coarse soil, such as sand, hold as much water during the dry weather as a fine soil? Do you think that a coarse soil covered with some fine material will raise a better crop?

Stirring the soil often also has the effect of holding the moisture.

Exercise III

Object. To find out how much rainfall the soils can take in.

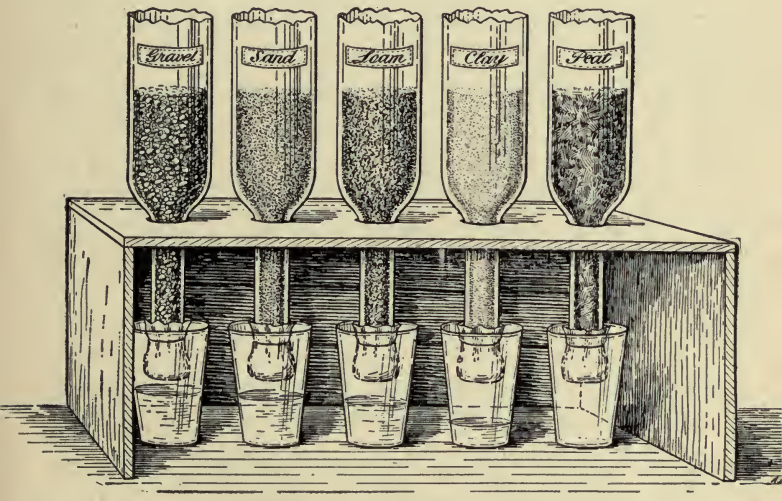


Fig. 1. — Apparatus to test the capacity of soils to take in rainfall.

Method. Break the bottom off 5 long-necked bottles like those in the illustration. Tie a piece of thin muslin over the mouth of each bottle and arrange

them in a rack with a glass tumbler under each one of them. Number the bottles *A*, *B*, *C*, *D*, and *E*.

Fill the bottles with soil: one with sand, one with gravel, etc. Fill to the same height after the soil has been lightly pressed by jarring the rack two or three times. Arrange to keep the apparatus standing several days.

Now, with watch in hand, pour water on top of the soil, just enough to keep it covered. Pour into one glass at a time, and note exactly how long it takes the water to begin to drop into the tumbler below. Do the same with each bottle. Tabulate and compare the results.

Rule the notebook for tabulated record as follows:

Bottle	A	B	C	D	E
Time Quantity of Water					

Which soil takes in water the fastest? Which is the slowest to take in water? Which soil holds the most water after a heavy shower of rain? How can a soil be made more porous?

Take two samples, equal quantities, of the same kind of soil. Put these samples in inverted long-necked bottles like those shown in this experiment. Pack the soil in one and leave the soil in the other

unpacked. Try this experiment on the soil in these bottles. What effect has packing the soil on the amount of water it retains?

To find out which soil will hold the greatest quantity of water measure the water in each glass after it has quit dripping. Be sure that the water is not wasted until after it has been measured. Tabulate.

Which soil drains most readily? Which do you think stores up the greatest amount of moisture? How can this knowledge be made use of in farm practice?

During the time that the water is dripping from the bottles, which may be several days, the glasses should be covered as well as possible to keep the water from evaporating.

What effect do you think that the water in the soil will have on the crop? Does the farmer want a soil that will not hold water? Why?

Exercise IV

Object. To determine the effect of lime on clay soil.

Method. Secure two long slender bottles. Cover the bottom of each of the two bottles one half inch thick with the finest clay that can conveniently be found. Fill the bottles nearly full of water. To one bottle add five or six teaspoonfuls of water to which has been added enough lime to make a milky liquid.

Shake each bottle until the contents are thoroughly mixed. Label each bottle so that you can tell at any time which has the lime in it. Set them side by side in the light and watch any changes that may take place. Look at the bottles once each hour during the first day, then once each day until the bottles are clear. Make a simple tabulation of the observations.

In which bottle did the water clear first? How long did it take the water to clear in each bottle? What was the difference in the time required to clear the water? What effect did the lime have on the clay soil? Can you tell why? What reasons can you give for putting lime on the soil? What kind of soil needs lime?

Mix a handful of clay with water and stir until it becomes like a thick dough. Let it dry. Now crumble both samples between the fingers. Can you see any difference?

Farmers put lime, a mineral that contains no plant food, on their fields to increase the crop yields. Can you tell why?

Explanation. Clay soils are made up of very fine particles which fit so closely together that air and water will not readily pass through them. It is almost impossible for the tiny roots to grow in such soils; if the soil is stirred while it is wet, it becomes very hard when dry. Lime causes the very fine particles to stick together in such a way as to form larger

particles, too heavy to be held up in the water. By making the soil particles larger the soil becomes more open and easier to work. Then there is room for air, water, and plant roots to pass between the particles and through the soil. It takes two or three tons of lime to cover an acre. Many so-called "worn-out" soils need lime in order to be made productive.

Lime has much to do with changing the plant food that is in the soil into a form so plants can use it. If some green crops like clover are grown and turned under to supply humus, and lime is then applied and harrowed in, worn-out soils will be much improved.

Exercise V

Purpose. To find out how plants get their food from the soil.

Method. Lay some pieces of very dark blotting paper or black cloth on a plate. On the paper or cloth place some pumpkin or radish seeds; moisten the paper and cover the seeds with another blotter or piece of cloth; keep the cloth or blotters moist. After a few days raise one corner of the cloth and see whether the roots are beginning to show. Where the roots have grown an inch or more remove the cover and observe the seeds and the roots carefully.

Can you see the tiny root hairs on the roots? They may not show plainly at first. Notice how many

there are and whether they are near the tips or at the base roots.

Cover the roots and leave them as they were before.

Fig. 2. — Tubercles on the roots of soy beans.

After a few days examine the roots again. Are there any root hairs on the larger roots? Are they just like they were when you saw them before? Are they all over the root or on only a part of it? What are the two uses of these root hairs to the plant?

Plant food from the soil is taken into the plant through these tiny root hairs.

This is the way the legume plants bring the nitrogen back to the soil.

Exercise VI

Object. To learn the power of the soil to take up moisture from the subsoil.

Method. Arrange four lamp chimneys as the bottles were arranged in Exercise III. Tie cheesecloth over the lower ends. Fill with one variety of soil as many chimneys as there are kinds of soils.

Pour water into the pan below until it stands about one half inch above the lower end of the chimneys. Watch the water rise in the chimneys.

In which soil does the water rise most rapidly? In which to the greatest height? Which soil do you think draws the greatest amount of water from the earth? Which soil will dry out the quickest? Which would bring moisture from the greatest depth?

The power of soils to bring the water from the subsoil is called **capillarity.** In dry weather the plants get their water from the soil in this way.

Does a light soil hold more water than a heavy one? In order to find out what is the lightest soil, measure a quart can full of sand and one full of clay. Which is the heavier? The lighter soil is easier to cultivate.

Exercise VII

Object. To show the power of water and frost.

Method. Fill a glass bottle with water. Cork tight. Keep it outdoors over night when the temperature is below freezing point. What happened to the bottle?

Look in the crevice of a rock where the water has frozen between the rock. What has happened to the rock? Look at the earth on the side of the road after it has been frozen. What is happening to it?

How does the water help to carry the hills away? Will earth that freezes and thaws be carried away faster than earth that never freezes?

Exercise VIII

Object. To show the bad effect of deep plowing on poor, sandy soils.

Method. Fill two boxes each eight inches deep nearly full with a poor quality of washed sand. Put a half inch of sand on the top of each box. Stir the soil in one to the depth of an inch. Stir the other well to the depth of seven inches. Plant one variety of small seeds in each box. Watch the growth of the plants in each box for several weeks. Which grows the faster?

When the plant food is mostly in the upper two or three inches of poor, sandy soil, what is the effect of plowing to the depth of seven or eight inches?

Exercise IX

Object. To tell the effect of puddling on the soil.

Method. Fill half full four tin cans, each holding one quart. Fill one with clay, one with sand, one with loam, and another with peat. Add water and stir until the soil becomes as thin as a paste. Set aside for fifteen minutes and stir again. Set in the sunlight and let them become thoroughly dry. A still better way of drying soil is to set it on the stove over a slow fire for a half day.

Examine the samples of dry soil. Which soil could be most easily cultivated after drying? Which

was baked? Which kind of soil could be worked soonest without danger of puddling after a rain? Which could be cultivated first in the spring? Describe the appearance of some soil that you have seen worked too soon after a rain. What effect does drainage have on such soils?

Exercise X

Object. To learn the effect on the moisture in the soil of plowing under manures.

Method. Close the larger ends of three lamp chimneys with muslin and fill each two thirds full of fine dry soil. In one chimney then pack one inch of finely cut straw, in another one inch of well-rotted manure, and on the other one inch of hard clay broken into pieces about the size of a pea. Now fill each chimney with fine, dry soil and set them in a pan containing a half inch of water.

Keep a supply of water in the pan. Watch the water rise in the chimneys. Does the moisture pass through to the top of each in the same time? What effect does the straw have on the passage of the water? What effect does the manure have? The clay?

The straw and rotted manure represent the material that is plowed under and lies in the bottom of the furrow. The clods represent the hard-baked surface of earth plowed under. The soil on the top represents the furrow that is turned under.

Compare this experiment with the actual farm practice. In which one of these three ways do you think that the crop would suffer least in the dry weather? Should straw or manure be plowed under in the spring or in the fall? When should hard-baked clay be turned under? Why?

PLANTS

Exercise I

Object. To show how roots take in moisture.

Method. (1) For material to be used in this experiment secure a wide-mouthed bottle, an egg, a glass tube four inches long and about a quarter of an inch in diameter, a candle, a piece of wire about five inches long.

Remove a small part of the shell from the large end of the egg without breaking the skin beneath the shell. This may easily be done by gently tapping the shell until it is full of small cracks and then picking off the small pieces. Take the shell from the small end of the egg from a place as large as the diameter of the glass tube.

Cut off a half-inch piece from the lower end of the candle. Bore a hole in the piece of candle the size of the glass tube. Warm one end of this piece of candle and stick it on to the small end of the egg so that the hole in the candle comes over the hole in the shell.

Heat the wire and with it solder the piece of candle firmly to the egg, making a water-tight joint. Place the glass tube in the hole in the piece of candle and solder it firmly with the hot wire.

Run the wire down the tube and break the skin of the egg under the end of the tube. Fill the bottle with water and place the egg on top of the bottle so that the water covers the larger end of the egg.

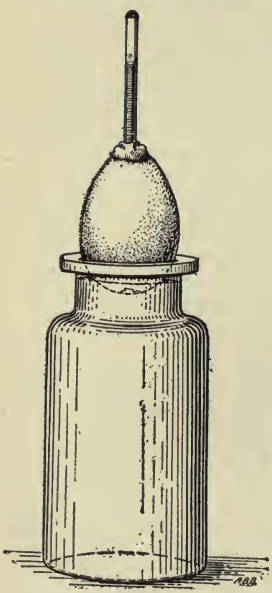


Fig. 3. — To show osmosis.

In an hour or so the white of the egg will be seen rising in the glass tube, because the water is making its way by osmosis into the egg through the skin. So far as can be seen even with a microscope there is no opening through the skin.

In this same way water which has the plant food in it enters the root hairs of the plants.

(2) The second way of showing how roots take in moisture. Remove the shell from the large end of the egg without breaking the skin. Break a hole in the small end of the egg and empty the shell. Rinse it out with water. Fill the bottle with water colored with a half dozen drops of strong iodine solution. Fill the egg partly full of clear water and set it on the bottle of colored water. The colored water will pass up into the shell and color the clear water in the shell.

(3) The third way to show the osmosis process.

Close the small end of a thistle tube and fill two thirds full of molasses. Then tie a moistened piece of bladder over the large end of the thistle tube. Put the tube up through the cork of a wide-mouthed bottle, filled two thirds full of clear water. Insert the cork and the tube in the bottle as shown in the illustration.

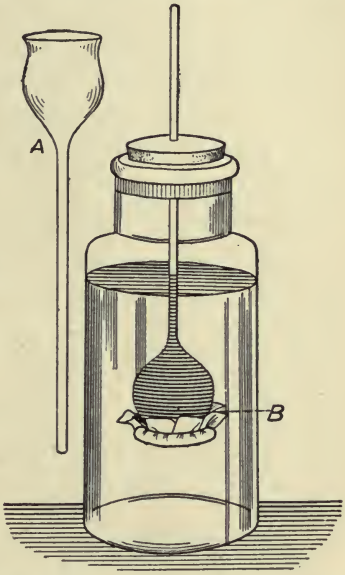


FIG. 4. — Osmosis shown with bladder membrane.

In a few hours the water will pass through the bladder and force the water to the top of the tube.

Can this experiment be made to teach something about the feeding habits of the plants? (Remember that all the mineral food is carried in the water.) Why is it of importance to know that the roots of the plants take up moisture from the soil? Can plants take in food that is not in solution? Why not?

EXERCISE II

Object. To determine the effects of light upon the germination and growth of plants.

Method. Fill two small boxes with dirt. In each box plant some corn, peas, and nasturtiums; a few other seeds may also be planted in each box. Moisten the dirt in each sufficiently for the seeds to germinate and grow.

Place one box in the window and the other in a dark place. A dark place can be provided in any room by covering the box with a larger box. Observe each box daily.

Is there any difference in the time it takes the plants to come up? Measure the growth of the plants at intervals of 24 or 36 hours. Is there any difference between those growing in the light and those growing in the dark? Is there any difference in color? Do the plants in the window grow directly upright or lean towards the window or lean away from it? Can you tell why the plants in these boxes grow as they do?

Allow the end of a nasturtium vine to grow through a small hole into a tight box. After a few days examine the vine. What changes have taken place in the part that grew through a small hole?

Make several small holes in the bottom of the box about three eighths of an inch in diameter so that the roots can grow through them. Make it dark on one side of the box. Do the roots all grow the same way after they come through the holes? Do you think the roots grow in the ground to be darkened or to get food for their growth?

Exercise III

Purpose. To determine whether plants grow towards light or away from the center of the earth.

Method. Provide a box about ten inches long, six inches wide, and six inches deep. Cut a hole as large as possible in one side of the box and cover it with a glass, putting the glass on the inside of the box.

Fill the box with ordinary dirt. While filling in, plant some peas against the glass near the bottom. Moisten the dirt enough for the peas to grow.

Observe the plants carefully.

After they have grown about an inch tilt the box by raising one end of it as much as possible without spilling the dirt. Leave the box in this position until the plants have grown another inch. Then place the box in the position it was at first and let the peas grow another inch.

Show by a drawing the direction in which the peas grew. Were the peas growing all the time the shortest way to the surface? What effect had the tilting of the box on the growing plant? From the way the plants grew do you think that light had any effect on them?

Exercise IV

Object. To show that part of the moisture taken in by the roots is kept in the plant.

Method. Pull up a green pigweed or other large green weeds. Wash the soil from the roots. Now

weigh the green plant. Then heat it thoroughly in a pan, but do not let it burn, until it seems to be dry. Weigh it again. Is there any difference in the weights? What makes the difference?

The difference in weight is about the amount of water that was in the plant. What per cent of water did the plant contain?

Try the same experiment by letting the plant remain in the schoolroom for a week. If ordinary scales are used, take four plants instead of only one. Does the plant continue to get lighter? Why?

Make a simple tabulation in the notebook of the weights of the plant from day to day. What does this record show? What causes the plant to wilt?

Exercise V

Object. To find the amount of mineral matter in the plant.

Method. Take a root of a pigweed and put it in an iron dish and heat it for an hour or until the smoke is no longer seen coming from it. What remains?

The ash that is left contains the mineral matter. How much of the plant is ash? Experiment with green and dry roots to see whether there is any difference in the percentage of ash in the plant. Record in the notebook the results of the experiments.

What per cent in weight of the plant is ash?

Do you think that the per cent of ash is the same in

the green and dry wood? Does the plant need a great amount of mineral matter?

Exercise VI

Object. To show the effect of the packing of the soil on the time of germination of the seeds.

Method. Plant some seeds in a box after the soil has been made damp. Pack the soil over part of the surface. Leave the soil loose over the remaining surface. Pressing a board flatwise over the surface is a good way to pack it. Make it rather solid.

Where do the seeds first come up? Make a simple tabulation in the notebook, recording the time it takes the seeds to germinate in each part of the box.

What would be the effect of rolling a loose soil? How can too rapid evaporation from the surface of a packed soil be prevented?

Stir part of the soil while it is wet and leave part of it as it is. What is the effect of stirring wet soil? Should the ground be plowed while wet?

Exercise VII

Object. To determine whether plants grow at night or during the daytime, and where growth takes place most rapidly.

Method. Provide some extra good soil for this exercise so the plants will grow rapidly. Soil from an old garden is generally good. Put the soil in a box or

can and plant some nasturtium seed and peas in the box. After the plants have grown up five or six inches make a mark with ink on the stalk near the base. Measure the plant from the mark at the base to the tip very accurately. Take a measurement early in the morning and again late at night. Repeat this two or three times. Record the measurements in tabular form. Mark the measurements to show which are night growths and which are day growths. This exercise may be carried on with several plants at the same time.

From the records taken determine whether the plants grow most in the daytime or at night. After some of the plants are eight or nine inches high measure several of them to determine where growth is most rapid. Place one end of a rule at the mark on the base of the plant and make other marks exactly one inch apart to the end of the plant. After two days apply the rule to the plant as when marking it. Are the marks the same distance apart as when made? Do these plants do all the growing at the end or farther down the stalk? Where is the growth most rapid?

Make an ink mark through the little leaf by the side of the stem and watch it grow the same as you did the stalk. Where does it grow the fastest? Put one of the plants in a glass with clear water so that the growth of the root may be watched. Mark one of the larger roots by putting pinholes through it at equal distances apart. Note the growth as often as

you do the other part of the plant. Where is it growing the fastest? Do some of the pinholes get farther apart every day?

Exercise VIII

Object. To determine the effects of light, water, and drainage on the germinating seed.

Method. Place some grains of corn or other seeds in a bottle of water; keep the bottle from extremes of heat and cold. Keep the seeds in the bottle of water for several days. Do the seeds germinate in the water? Note any changes that take place in these seeds. Do seeds need anything but water to cause them to germinate or sprout? How about the temperature?

Place some wet blotting paper on a plate; put some grains of corn or other seeds on the blotting paper and cover them with a flat glass. Keep them moist and leave them in the plate a few days. What difference do you notice between the seeds in the plate and those in the bottle? Do you think that the light has anything to do with germination?

Fill two small cans with the same kind of soil. Punch little holes in the bottom of one to let off the water that is not needed; the other should have a water-tight bottom. Plant a few seeds, the same number of one variety, in each can at one time. Pour the same amount of water into each can, enough to start the seeds growing. This will keep the soil very

wet in the tight can. Observe the seeds from day to day. The seeds in which can sprout first? How many seeds in the other can sprout later? Why do the most of them decay?

Why does the corn not grow in some fields when it rains for four or five days after it is planted? Would draining it help? Do you know of any soil that you think needs draining?

Exercise IX

Object. To show that plants give off moisture.

Method. Take a plant that is well started in a flower pot. Secure a piece of cardboard, a glass tumbler, or jar large enough to cover the plant. Cut a slit in the cardboard and draw it around the plant as shown in the illustration. Seal the slit with tallow so that no moisture can come up through it from below. Cover the plant with the glass and set it in a sunny place. Observe what takes place in the glass from time to time. Tabulate the notes on the observations.

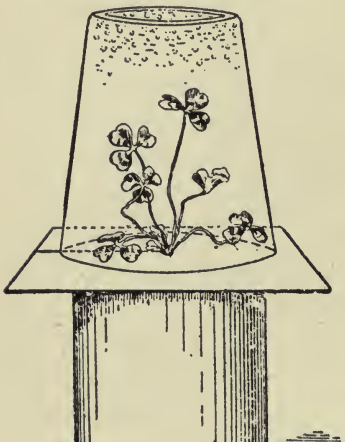


Fig. 5.—To show that plants give off moisture.

Moisture will condense

on the inner surface of the glass. Where does it come from? Is all the moisture absorbed by the roots given off this way? How can you find out?

Why do plants need water?

Exercise X

Object. To show the rise of water in plants.

Method. That the water absorbed by the roots of plants is forced upward can be demonstrated by severing the stem of a geranium three inches from the surface of the soil, setting on top of the cut end of the stem a section of glass tubing several inches long, and fastening the two together by wrapping the joint with a strip of sticky tape. Keep the root of the plant normal by supplying it with water. Note what happens inside the glass tube, observing it every few hours.

Make notes based on the observations and record the information in the notebook.

Exercise XI

Object. To show circulation of water in plants.

Method. To show that water solution circulates to all parts of the plant, fill a tumbler one third full of warm water to which a few drops of red ink or some other brilliant coloring matter has been added. Place in the colored water the freshly cut stems of white carnations, white roses, lilies of the valley, and other

white flowers, twigs of trees with young leaves on. Be sure that they are fresh. In this manner the colored water will circulate through the stems or twigs and may be seen distributed in veinlike patterns through the petals of the flowers or through the leaves. Hold the leaves up to the light and the coloring matter can be seen more clearly. In this manner the stem carries to the plant in solution food which has been absorbed by the roots.

Exercise XII

Object. To learn the conditions essential to plant growth. *Moisture.*

Method. Take two pots or tin cans in which plants are growing. Keep them under like conditions except that one is watered and the other is not. Let them stand for several days. Notice the difference in the habit of growth of these two plants? Is moisture necessary to plant growth? Why?

Object. To learn the conditions essential to plant growth. *Heat.*

Method. Take two growing plants in tin cans or pots and keep them under similar conditions except that one is to be kept warm, from 60 to 80 degrees F., the other from 20 to 40 degrees F. Notice the difference in their growth.

Plant seeds in boxes and observe the difference in time of germination. Radish seeds are good for this experiment. Keep one box outside where the temperature is cool and the other in the house or where the temperature is much warmer. Which grows the faster? Why? Does one look more healthy than the other?

Object. To learn the conditions essential to plant growth. *Light.*

Method. Take three cans or pots which contain growing plants. Put one in the dark, one in a poorly lighted place, and one where the sun can shine upon it. In a few days notice the difference in the growth of the plants. How does the light affect the growth of the plants?

Visit a place where there is a heavy growth of trees and see if the limbs are not more spindling where there is more shade. Why? What is the difference in the limbs when they are out where the sun has its direct rays shining upon them?

Notice the color of the potatoes growing in the cellar where the sun does not shine upon them.

Is the light necessary for the growth of the plants? Is it necessary for the plant to become green? Look for plants growing in the dark and compare them with plants growing in the light.

Exercise XIII

Object. To learn the parts of the flower.

Method. Bring to the class several kinds of flowers. Examine the flowers to see how many different parts there seems to be to each one. Do you think from looking at them that all flowers have the same number of parts? Do you think that there are as many stamens on some flowers as there are on others?

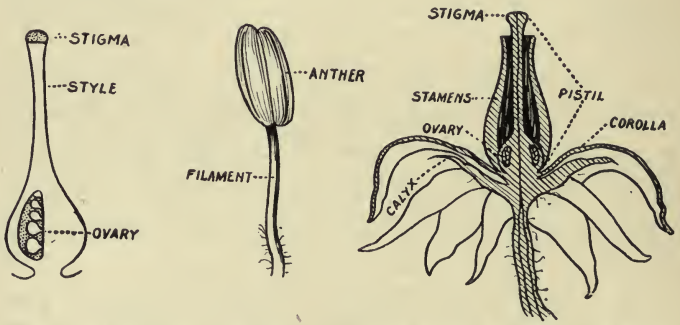


Fig. 6. — A stamen. A pistil. Vertical section of tomato blossom.

From the illustration learn the names of the different parts. See whether all flowers have a single pistil.

Of what use do you think the flower is in reproducing others of its kind? Can you think of any plants that do not have flowers? Does the fern reproduce by flowers or spores? Do you think that all flowers that reproduce from seeds would need flowers? Why?

CULTIVATED PLANTS

Exercise I

Object. To observe growing corn in the field.

Method. Study the height of the corn, the size and the shape of the ear. Notice the direction in which the ears point. Make drawings to show the general outlines of the plants. Do you see any stalks with no ears on them?

Has the corn made a good growth? Is there any disease in the corn that you can see? Does it show good cultivation?

Can you think of any way that you could raise, on the same ground, a better crop?

Fig. 7.— Growth of corn roots. Notice the roots extend farther from the main stalk and do not go so deep because the soil has been well cultivated and more plant food is available. The horizontal line shows the roots also start deeper.

Exercise II

Object. To study the stalk of corn.

Method. Bring to class a stalk of corn with the roots on it. Measure the height of the stalk. Would a taller or a shorter stalk be more desirable? Give reasons for your answer.

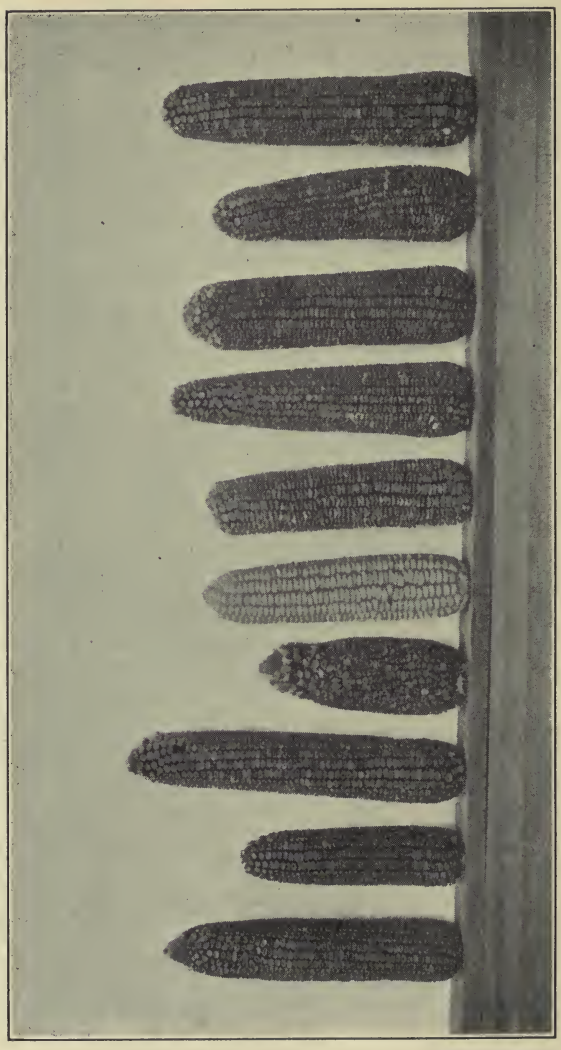


FIG. 8. — Showing ten poor ears of corn poorly arranged.

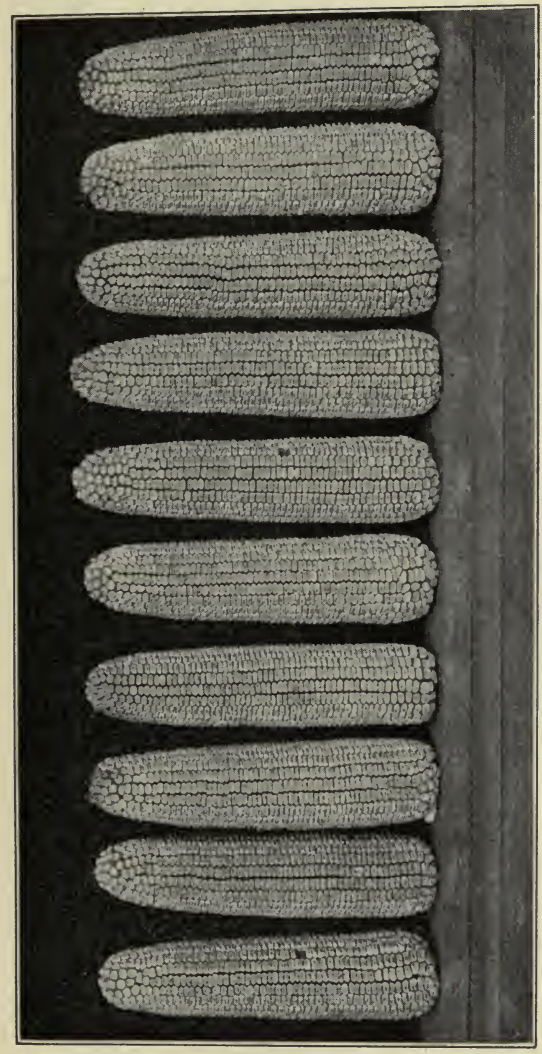


FIG. 9. — Showing ten good ears of corn well arranged.

Make a drawing of the whole corn stalk, locating the leaves and the ear. Measure the distances between the nodes. (The word "joint" is sometimes used for node.) Notice how the distance between the nodes varies.

Indicate on the drawing the parts that are improved. Tell why they are improved.

After carefully studying the stalk make a drawing of a cornstalk as you think it ought to be.

Note the variety of cornstalks in the cornfield.

Make measurements of the parts of a number of specimen stalks and tabulate the data. Obtain information to show it. What is the average height of the stalk? What is the average length of the shank of the ear? Is the husk loose or close, abundant or scarce? How high is the average ear from the ground? Are there many stalks that have no ears on them? How would you improve the yield of corn?

At what time of the year is corn ready to be gathered?

Exercise III

Object. To find variation in corn.

This experiment is to be tried in the fall before the corn is husked. Go out in the cornfield to make the measurements. Use the foot rule or yardstick.

Method. Make the measurements in the cornfield on growing corn.

	1	2	3	4	5	6	7	8	9	10
Height of stalk . . .										
Height of ear										
Length of shank . . .										
Length of ear										
Direction the ear points .										
Number of leaves . . .										
Width of widest leaf . .										
Width of narrowest leaf .										
Length of longest leaf .										
Length of shortest leaf .										

Exercise IV

Object. To study an ear of corn.

Method. Describe the ear of corn according to the following outline:

1. Color of the ear.
2. Name of the variety.
3. Color of the grain and cob.
4. Is the surface smooth or rough?
5. Note the straightness of the rows, spacing, and the completeness.
6. Grains loose or firm?
7. Butts even, shallow, or deep.
8. Tip well filled.
9. Shape of the ear.
10. Shape of the kernels.
11. Length and circumference of the ear.
12. Find the weight of the ear and of the corn. What per cent of the weight of the ear is the corn?

Exercise V

Fig. 10. — A poor corn butt.

Object. To study the structure of a grain of corn.

Method. Place in water a dozen grains of corn. Examine the corn grain after it has been in water one day.

With a knife remove the tip at the end of the kernel. Remove the entire hull from the grain in strips. The hull is the thin coat that peels off. The part under the hull is called the horny gluten. Remove it, scraping it with a sharp knife. The germ or embryo is the little point at the tip of the kernel where the growth seems to begin. Remove the embryo

Fig. 11. — A poor corn tip.

next. The cuticle contains the plumule, the first green leaves. Carefully notice the plumules, how

FIG. 12. — A good butt.

FIG. 13. — A good tip.

they have already started to grow. After all these parts have been removed nothing but the starch remains.

FIG. 14. — Poor kernels.

This starch is of two kinds. The horny starch is at the sides and back of the kernels, while the granulated or smooth layer is on the inner side. Make drawing and label each part.

FIG. 15. — Good kernels.

EXERCISE VI

Object. To find out the average number of ears of corn in a bushel.

Method. Let each pupil weigh one bushel of corn and count the number of ears in it. Divide the total weight of the bushel of ears by the number of ears to get the average weight of each ear. Then bring to school the average ear and weigh it and see if it is about the weight of the average ear in a bushel. Then weigh each ear in a bushel and see how much the bushel weighs.

How many average-size ears of the variety studied are in the bushel?

EXERCISE VII

Object. To find the number of kernels in an ear of corn.

Procedure. Count the kernels in a row. Then count the number of rows in the ear. Multiply the number of rows by the number of kernels in the row to get the number of kernels on the ear.

When sixty ears make a bushel, how many kernels in the bushel?

Compare the ears as to size. Count the kernels on the smallest ear, then on the largest, and see how they differ.

If the sample is an ear of yellow corn, examine to see how many white grains in it.

How many of the rows do not extend the full length of the ear? Explain how the size of the cob has something to do with this. Does the butt of the ear have extra rows in it? If it does, can you give a reason for it? Why does the number of rows vary even if the ears are the same size?

Exercise VIII

Object. To determine how good seed affects the corn crop.

Method. Test some corn by the method given in Exercise IX. What per cent of this corn will grow? Try more than one sample of corn.

There are fifty rows of corn with eighty hills in each row in an acre. How many hills are there? The rows must be about forty-two inches apart and the hills thirty-six inches apart in the rows to make just one acre.

If there are three stalks in each hill, how many stalks on an acre? If each stalk bears one ear, how many ears will there be on the acre?

If it takes 100 of these ears of corn to make a bushel, how many bushels on the acre? If it takes two bushels of ears to make one bushel of shelled corn, how many bushels of shelled corn on the acre?

If 20 per cent of the corn is nubbins, how many bushels of nubbins? How many bushels of good corn? If one had used seed corn like that you tested, how many bushels would the acre have produced?

Exercise IX

Object. To learn the ways of testing seed corn.

Method. Take a piece of muslin and mark it off into two-inch squares. Number the rows as 1A, 2A, 1B, 2B, and so on. Number the ears in the same way with a small piece of paper and fasten the number in the butt of the ear with a pin.

Take two kernels from the butt, two from the middle, and two from near the tip and lay them in each square. Roll the muslin up in a roll and keep it damp for two days. Unwrap it to see how many of the kernels have sprouted. The ear should not be planted unless all six of the kernels start to grow. This is called the "Rag Doll" Tester.

A second method is to make a box as shown in the picture. It is made in two-inch squares. The strings are strung as indicated. Sawdust or sand is placed in the box. Six kernels are placed in each square, as in the other tester. A piece of muslin is then placed

over the box and is covered with a half inch of sand or sawdust. This should be kept damp for two or three days. Then the cloth should be raised so that one can tell how many of the kernels will grow.

FIG. 16. — A germinating test box.

These testers should not be kept in a place that is very warm, even if it takes longer for the corn to start to grow. The conditions should be more like those out of doors. Unless every kernel starts to grow, the ear should not be used for seed. Why is a perfect stand to be desired?

Exercise X

Score Card for Corn

	Ears					
	Score	1	2	3	4	5
Trueness to type . . .	10					
Shape of the ear . . .	10					
Color: (*a*) Grain . . .	5					
(*b*) Cob	5					
Market conditions . . .	10					
Tips	5					
Butts	5					
Kernels: (*a*) Uniformity .	10					
(*b*) Shape. . .	5					
Length of ear	10					
Circumference of the ear .	5					
Space: (*a*) Between rows.	5					
(*b*) Space between kernels at the cob	5					
Proportion of corn to cob	10					
Total	100					

Ten ears make a sample.

Explanation. 1. Trueness to type. — The ear samples should possess like characteristics and should be true to the variety which they represent.

2. Shape of ear. — The shape of the ears tapers slightly from butt to tip; not too much.

3. Color: (*a*) grain; (*b*) cob. — Colors of the grain should be true to the variety and free from mixture. White corn should have white cobs. Yellow corn, red cobs.

4. Market conditions. — The ears should be sound, firm, well matured, and free from mold, rot, and other injuries.

5. Tip. — The tips of the ears should not be tapering and should be well filled with regular uniform kernels.

FIG. 17. — Enemies of the corn crop. (*Courtesy of Country Gentleman.*)

6. Butts. — The rows of kernels should extend in the regular order over the butt.

7. Kernels: (*a*) uniformity; (*b*) shape. — The kernels should be uniform in shape, size, and color, and true to the variety. The kernels should be so shaped

that their edges touch from top to crown. The top proportion should be full and plump.

8. Length of ear. — This depends where grown. In the northern section, 8 to 9 inches. In the central section, $8\frac{1}{2}$ to $9\frac{1}{2}$ inches. Southern section, $8\frac{3}{4}$ to $9\frac{1}{4}$ inches.

9. Circumference of ear. — In the northern section, 6 to $6\frac{1}{2}$ inches. Central section, $6\frac{1}{4}$ to $6\frac{1}{2}$ inches. In the southern section, $6\frac{1}{2}$ to 7 inches.

10. Space: (*a*) Furrow between rows; (*b*) Space between rows and the furrow between the kernels should be small. Much space between the kernels is objectionable.

11. Proportion of corn to cob. — The proportion of corn to the cob is determined by weight; depth of kernels, size of cob, and maturity all affect the proportion.

Exercise XI

Fig. 18. — Corn rootworm; *a*, larva; *b*, pupa.

Object. To study the corn rootworms.

Method. First look at the picture and then go out in the cornfield and see if you can find one or more of these corn rootworms. Write to your experiment station for their bulletin on the corn rootworm. In this way you can get the life history and habits of it, also the amount of damage that it

does. The bulletins will also discuss the methods of its control.

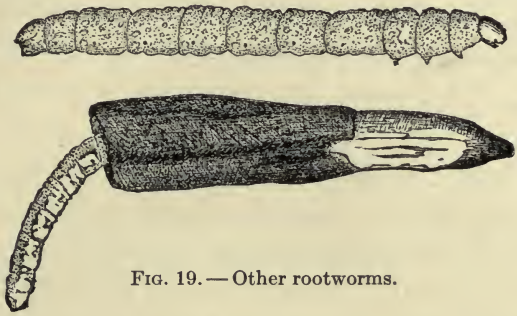


FIG. 19. — Other rootworms.

Write in your notebooks all you learn about this worm.

EXERCISE XII

Object. To study the wheat plant.

Method. Take a trip to the wheatfield nearest the schoolhouse. Notice whether or not the stem stands up well. Is there a good stand of wheat? The heads should be well filled out.

Take several wheat plants to the schoolhouse and make drawings of the root systems of the stems and of the heads. Make the drawings from one of the best and from one of the poorest plants and notice the differences. Notice whether or not more than one plant comes from the same stem. The branches are called the stools.

Do you think that the thickness of the stand has

anything to do with the stooling of the wheat? Notice whether stooling is greater in good soil.

Exercise XIII

Object. To study the oat plant.

Method. Take a trip through an oatfield for a close study of the plant. Notice the stand, the stooling habits, the way the stalks stand, and the soil.

Bring plants to school and study them as you did the wheat plant. After carefully drawing the root, the stem, and the head, compare each part with the corresponding drawing of the wheat plant. Do you see any way that the yield may be improved?

Oats may be treated for smut in the same way potatoes were treated for scab.

Exercise XIV

Object. To see if there is any starch in the corn or wheat grain and other seeds.

Method. When there is starch in any grain, a little iodine solution will turn it blue. To make the iodine solution take a few iodine crystals, put them in a bottle, and pour in enough water to cover crystals. Put a drop of the solution on a piece of starch and see how soon the starch will turn blue. Cut a grain of corn in pieces both crosswise and lengthwise and put a drop of iodine on the parts. Do the same thing with grains of wheat, oats, beans, and other seeds.

If there is much starch in the grain, it turns dark blue, and if little starch is there, it turns light blue. What tested seeds do you think have much starch? Which do you think have no starch in them? In what part of the seed is the starch?

Exercise XV

Object. To see if the corn and other seeds contain protein.

Method. Take three grains of corn and make them into a powder by pounding in a mortar. Place the powder in a test tube, pour a few drops of nitric acid upon it, and boil over a lamp. The protein turns yellow. Pour in a few drops of ammonia and the mixture will turn yellow. If nitric acid gets on the hand, wash it off with cold water at once. What seeds contain protein? Which of these seeds do you think have the most protein in them?

Exercise XVI

Object. To see whether there is fat or oil in corn and other seeds.

Method. Take some corn grains and other seeds and make them into a powder by pounding. Place them on a piece of paper and heat them on a tin, but not enough to burn them. If there is oil present, it will make a greasy spot on the paper. Fill out the table, making a simple tabulation.

Seed Tested	Starch	Protein	Sugar
Corn			
Wheat			
Peas			
Beans			

Exercise XVII

Object. To determine the degree of seed.

Method. Collect all the varieties of seed that are to be found in the community. They may usually be found along the roadside. The school yard is usually full of weeds such as lamb's-quarter, ragweed, buck plantain, and pigweed. Save in bottles a few seeds of each variety.

Get a sample of as many varieties of grass seeds as can be found. Some of the children can bring red clover, some timothy, some alfalfa, others redtop, and any other small seeds that can be found in the home or the neighboring store. Count out a hundred seeds from each sample that is brought. Find out the number of pure seeds. Find out the number of each of the other kinds of seeds. What per cent of the sample is pure seed? What per cent is pigweed seed? What per cent of each other kind of seeds is in the sample?

Test the seed obtained from a stand of pure seed to see how many will grow. Take some heavy

blotting paper and put it in the bottom of a plate. It must be wet first so that the moisture will cause the seed to grow. After all the seeds have been spread on the paper put another heavy paper that has been dipped in water over them. Cover over with a plate and leave for two days. Count the seed after two days and see how many of them are growing. Keep in a warm place or it will take longer. What per cent grow?

Why does it not pay to sow seed that will not grow? Can you give a reason why so many farmers have a poor stand of grass? Why are so many different kinds of weeds found in a field that was sown in grass that year? Does it pay to test grass seed before it is sown? Why?

Exercise XVIII

Object. To determine how good seed affects the crop.

Method. Place a large blotter in a plate. Count fifty or one hundred seeds and put them on the blotter. Cover them with another piece of blotting paper and moisten the blotters sufficiently for the seeds to germinate. If small seeds, such as wheat, radish seeds, or flaxseeds, are used, one hundred can be put in the plate. If corn, peas, or other large seeds are used, fifty will be enough. Do not pick out the best seeds, but use those first picked up. Keep the blotters moist

and look at the seeds occasionally to see if they have sprouted.

When the seeds begin to sprout, take out those that have sprouted each day. Record the number. Make a simple tabulation in the notebook in order to keep the record correctly.

Kind of Seed	Wheat	Radish					
Number tested . .	100	100					
Number sprouted .							
Per cent sprouted .							

When all that will have sprouted, count the number that have sprouted. How many have sprouted? How many did not? What per cent of the seeds sprouted?

If it takes 756,000 grains of wheat to seed an acre when every seed grows, how many plants will be missing on the acre if the same per cent of wheat grains failed to grow? What effect will this kind of seed wheat have on the yield?

Exercise XIX

Object. To study a standard variety of potatoes (Early Ohio).

Method. Bring a potato to the class and study it with the outline.

Shape. — Oval, blocky, thickened.

Color. — A red tinge.

Size. — Medium.

Surface. — Dotted or dimpled, slightly bulging around the eyes.

Eyes. — Numerous and evenly distributed.

Flesh. — Yellowish white to white, slight rose color extending beneath the eyes at the bud end. (The bud end is the end the farthest from the attachment of the stem.)

Flesh. — Firm and therefore a potato of good keeping and cooking qualities.

Vines. — Upright at first, becoming spreading as they get older.

Leaves. — Broad, dark green color, subject to tip burn.

Seed. — Select the medium size.

Make a drawing of the potato, natural size. Give the location and the number of eyes. Would you consider the sample good for seed? Why?

Some points to look for in selecting a good variety of potato are: good flavor and quality; starch evenly distributed and not soggy; ability to mature before frost.

Late varieties usually yield more than the early ones.

Some potatoes have less diseases than others.

A rough skin is thought best.

The eyes should not be too deep, as deep eyes may cause decay. If there are too many eyes, there is a waste in cooking. The variety should be true to type or it will run toward a scrub.

Exercise XX

Object. To treat the seed potatoes to prevent the scab.

Method. Have the children bring to school samples of the scabbiest potatoes that can be found. Purchase

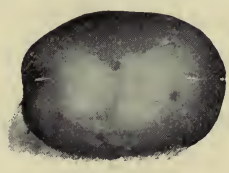
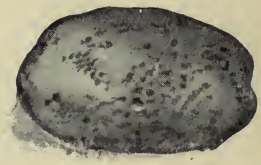


Fig. 20. — A good potato.



A scabby potato.

at a drug store for about 40 cents a pint of formalin solution.

Place the potatoes in a burlap sack. Fill a bucket about two thirds full of water. Put into this water about one tenth of a pint of the formalin. Place the sack in the solution and leave it there for one and a half hours. Potatoes so treated may be planted without fear of raising scabby potatoes. These potatoes may be planted at home and reported on at the beginning of the next school year.

Exercise XXI

Object. To learn something of the life and habits of the Colorado potato beetle.

Method. Collect a few Colorado potato beetles, put them under an inverted glass tumbler with some

potato leaves and watch them eat. Place the tumbler on some dirt so that the beetles can go down into the dirt.

Perhaps the potato beetle is so common that every one knows it at sight and already knows how it eats.

FIG. 21. — Potato beetle at work.

Is it a "chewing" or "sucking" insect? Then how may one destroy it?

The soft reddish larvæ of the potato beetle is called a grub. Is it the grub or adult beetle that eats the potato leaves? Have you seen them both eating together? After the grub has eaten all that it wants it goes down into the ground, forms a little case around itself, and soon comes out an adult beetle. The adult beetle spends the winter in the ground.

What effect would winter plowing have upon the potato beetle?

Have you seen any other beetles on potatoes besides this one? The blister beetle, a long slender black beetle, is often found eating potato leaves. Have you ever seen either of these beetles eating any other plants?

Read Circular No. 87, U. S. Department of Agriculture, Bureau of Entomology.

WEEDS

Exercise I

Object. To become acquainted with the seed of weeds that grow near the schoolhouse.

Method. Get from the drug store three dozen of the smallest bottles. Have each child make a collection of the different weed seeds that can be found. Label the bottles and save for further study.

The children should write a brief description of each kind of seed. In this way the children may learn to know the seeds.

Read the government bulletin on the seed of weeds to learn the names of the seed. This bulletin may be obtained by writing to the Secretary of Agriculture, Washington, D.C.

Exercise II

Purpose. To find out how weed seeds are scattered.

Method. Make a list of the weeds that bear seeds. Which of these seeds are commonly scattered by man? By birds? By the winds? By the water?

Some weed seeds stick to clothing and may be carried long distances, some are bought and sowed with grass seed, some are found in hay that is fed to cattle and horses, some are blown across the country by the winds, and some are carried by the birds.

Some strange weeds are found growing along railroads. How did they get there?

Some weeds begin growing along the banks of streams and later spread over the country away from the streams. How did the seeds probably find their way to the banks of the streams?

Seed of Weeds	Scattered by			
	Man	Birds	Winds	Water

HORTICULTURE

Exercise I

Object. To learn how to graft. Cleft graft.

Method. Saw off the limb of the tree where the graft is to be put in. Cut the graft from the last year's wood. A young vigorous growth is to be preferred. The graft should be cut off just above a bud. Leave at least three buds on the graft. Sharpen the graft about three fourths of an inch long into a slender wedge shape. Leave the outer side a little fuller than the inside. Leave a bud on the outer edge at the top, just where the graft comes even with the other wood. Split the top of the limb in the middle far enough to let the graft go into

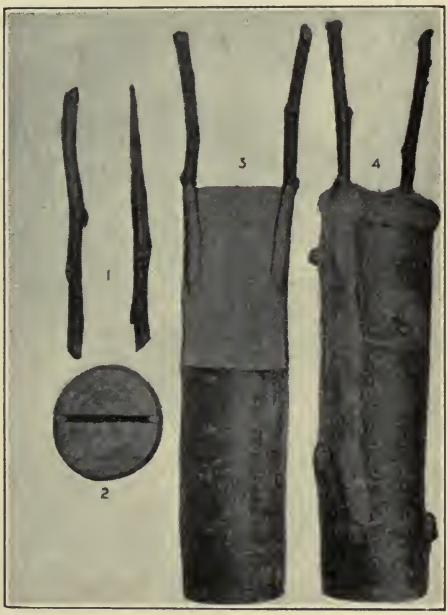


Fig. 22. — Cleft graft. 1, graft; 2, scion ready for grafts; 3, grafts in place; 4, waxed ready to grow.

the wood. Do not try to get the outer sides even, but try to get the growing layers even so that they can grow together. Cover the exposed ends with grafting wax. Be sure that all the cut or sawed ends are securely covered with wax.

Exercise II

Object. To learn how to whip graft.

Method. Take a small root or twig, a water sprout from the apple tree makes a good material for this exercise. Cut it as is shown in the illustration. Use a sharp knife to make the cut. The cut should be at least an inch long. The scion and the graft should be about the same diameter. The tongue fastens the joint more firmly. The growing layers will in this way be placed together. Use raffia to tie the joint together. Wrap it around from the bottom and make a loop in the last round at the top so that it will not be necessary to cut it at all.

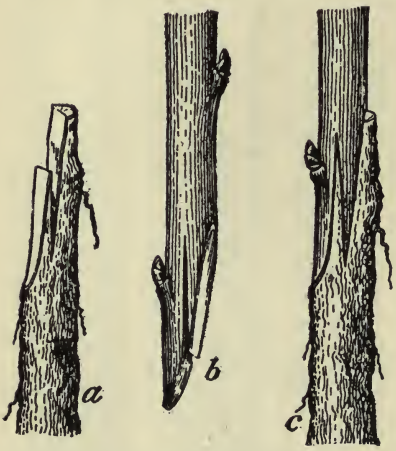


Fig. 23. — Whip grafting. *a*, the stock; *b*, the scion; *c*, stock and scion united.

Graft in the dormant season.

FIG. 24. — Whip graft when the graft is smaller than the scion.

EXERCISE III

Object. To learn how to bud.

Method. The peach and the cherry are more often budded. The bud is placed as near as it is possible to the ground. Make the cut on the tree as is shown in the illustration. First cut the bark around the top of the place where the bud is to be inserted. Then make the perpendicular cut. This cut may be an inch long. Cut the bud stick from a growing tree off the last year's growth. Use a sharp knife; open a ver-

tical cut above the bud. Then make the main cut as is illustrated. Let the knife extend a little into the wood, so that it is sure to extend through the growing layer. Raise the opening at the top with a knife and slip the bud into the opening.

To hold the bud in place wind raffia around it as shown in the illustration. Commence to wind at the

BUDDING

FIG. 25. — Budding. *a*, cutting the bud; *b*, making the cut; *c*, the bud in place; *d*, the bud wrapped with raffia, ready to grow.

bottom, fastening the end of the raffia as it is being wound around the bud by keeping the end under the first layer. Draw a slipknot in it to fasten the raffia without tying it, so that it will not be necessary to untie it as the growth proceeds. After the bud has grown a foot long cut off the top so that the bud can use all the plant food that comes up the stem.

Budding should be done during the growing season. Can you tell why? Why is budding usually done near the ground and before the tree is transplanted?

Exercise IV

Object. To determine how cuttings start to grow.

Method. Locate a wet place in the ground or provide a rather large box of dirt that can constantly be supplied with plenty of water. Secure two live willow twigs about as big as a lead pencil or a little larger. If willow cannot be had, Carolina poplar may be used instead. Place the base end of one of the twigs and the top end of the other well down in the wet earth. Leave them several days, but observe them occasionally. After they begin to grow notice them oftener. Make notes of the observation and tabulate the results in the notebook.

Is there any difference in the growth that takes place? Does either one have both branches and roots growing on it? Which one has roots? In what direction do they grow, upright or drooping? In what direction do the branches grow? Are the roots and branches at the end or all along the twig?

Some plants will grow from the leaf. Cover a begonia leaf, if one can be found, in moist sand and watch it for a week.

Plants may also grow from cuttings alone. Cut some grapevines 12 inches long and keep them in moist sand for a few days. Do they start to grow?

The geranium may grow from the stem. Take a short stem and place it in some moist sand and see if the roots do not start to grow.

Some plants may start to grow by the tops bending over until they reach the ground. See whether you

Fig. 26. — Raspberry layering.

can find a blackcap raspberry plant like the illustration growing from the tops reaching the ground.

Take a careful record of all the things found out in this exercise.

Exercise V

Object. To learn how to make spray material.

Method. This experiment can be done at home and the results may later be written in the notebook.

To make Bordeaux mixture. Take two pounds of copper sulphate, put it in a sack, and hang it in a bucket of warm water over night. Slake four pounds of lime in enough water to make a paste. Pour these two solutions together in about twenty-four gallons of water. Use in the spray pump before it settles.

To make lime sulphur spray. Slake twenty pounds

of lime in an iron kettle in as little water as possible. Then add enough water to make ten gallons. Heat to the boiling point. Put a stick in the water and make a mark on it to where the water comes. Add the sulphur as it boils; keep stirring all the time. When the sulphur all goes into solution, let the mixture cool.

Use one gallon of this solution to eight when the spray is used before the leaves come out. Use one gallon to twenty of water after the leaves come out. The first is for the scales and all other insects that suck. The second is as strong as it can be used without killing the leaves.

Usually two pounds of arsenate of lead to a barrel is used with it to kill the codling moth and the caterpillars. Mix the arsenate of lead with water enough for a paste and pour into the pump.

A bulletin containing information on the making of spray material may be obtained from the State Agricultural Station or the State Agricultural College.

Exercise VI

Object. To learn the cause of "wormy apples."

Method. Bring to the class four or five apples that have dropped from the trees. Cut the apples into halves and see if there are any "apple worms" in them. See if you can see where the worms came into the apple. If they have left the apple, can you tell where they went out?

The apple worm is not a "worm," but a little caterpillar, the larva of a small moth. After the caterpillar has eaten all it wants it leaves the apple and goes under a piece of bark or other place and hides away during the winter. When spring comes, the caterpillar changes to a moth. The adult moth lays eggs on the young apples and leaves. The eggs hatch, and the very small caterpillars crawl to the calyx of the nearest apple and enter it. The end of the apple opposite the stem is called the calyx.

FIG. 27. — The codling moth. (Courtesy of B. F. Johnson Pub. Co.)

The apple worm is also called the codling moth. Just as the petals of the apple blossoms begin to fall the calyx of the apple is open wide. In a few days it closes up.

When then should spraying for the codling moth be done? What birds destroy many codling moths by pecking holes through the loose bark of the trees and eating the larvæ?

Do you see any difference in the size of the apples that have moths in them and those that do not? Describe this difference. Do you see any apples on the

market that have the codling moth larva in them? Apples containing this larva are usually hindered in

FIG. 28. — Apples from sprayed and unsprayed branches. (Courtesy of B. F. Johnson Pub. Co.)

growth and fall off early. Read the last paragraph of Exercise V.

FIG. 29. — Time to spray. Too late to spray.

Read Farmers' Bulletins No. 171 and No. 247, U. S. Department of Agriculture, Bulletin No. 35, Bureau of Entomology, U. S. Department of Agriculture, Washington, D.C.

DOMESTIC ANIMALS

Exercise I

Object. To learn to locate the parts of the horse.

Method. Study this picture in the class until you are pretty sure that you can tell where each part of the

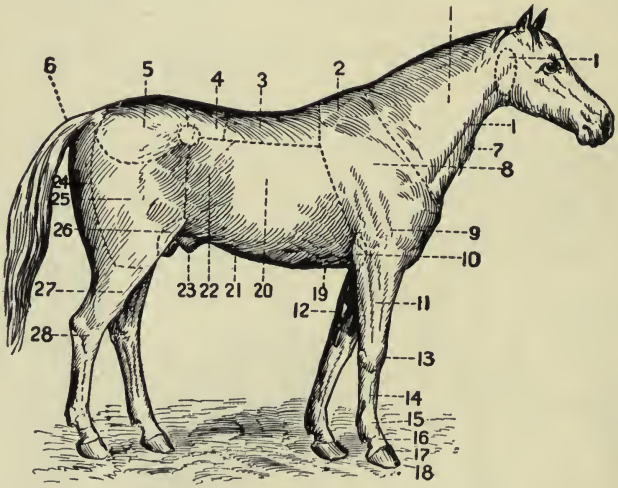


Fig. 30. — Diagram of horse. 1, neck; 2, withers; 3, back; 4, loin; 5, hip; 6, dock; 7, throat; 8, shoulder; 9, breast; 10, forearm; 11, arm; 12, wart (x); 13, knee; 14, cannon bone; 15, fetlock; 16, pastern; 17, hoof; 18, toe; 19, chest; 20, ribs; 21, belly; 22, flanks; 24, gaskin; 25, quarters; 26, stifle; 27, thigh; 28, hocks.

horse is located. Have a horse brought to school. Study the horse and locate all the different parts.

Make in the notebook an outline drawing of the horse; sketch in the parts and name each part on the drawing.

Exercise II

Object. To learn the breeds of horses.

Method. Have as many breeds of horses as possible brought to school. Try to have the Percheron and the Clydesdale breeds. Learn the different parts by comparing one with the others. Notice the difference in the shape of the little road horse and the heavy draft horse.

See if you can tell why the shoulders of the big draft horse are not so long as the driving horse. Could it pull as well with long shoulders as with short ones? Would the road horse have as much spring with short shoulders as with long ones? What difference do you see in the size and the shape of the feet of each? Is the neck of each the same size and shape? Does one have a wider breast than the other? Is the back of one broader than that of the other? Is one higher off the ground than the other? Is the draft horse heavier than the other?

Exercise III

Object. To learn the breeds of cattle.

Method. Have the children look at the many breeds of cattle in the community. Study books in the library on the breeds of cattle. Make in the note-

FIG. 31. — Dairy type.

book a record of the points mentioned on each breed.

Cattle are divided into two main types: the beef

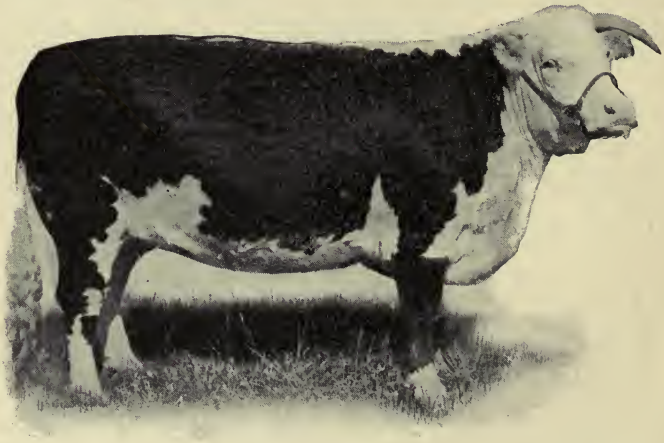


FIG. 32. — Beef type.

type and the dairy type. Some books mention a dual purpose type, but it is better either for beef or milk.

After a close study of the pictures make a list of all the points that are different in a dairy cow from the beef breeds.

Exercise IV

Object. To learn the parts of the cow.

Method. First learn the names and where the parts are located in the picture. Then study a cow, naming and locating the parts.

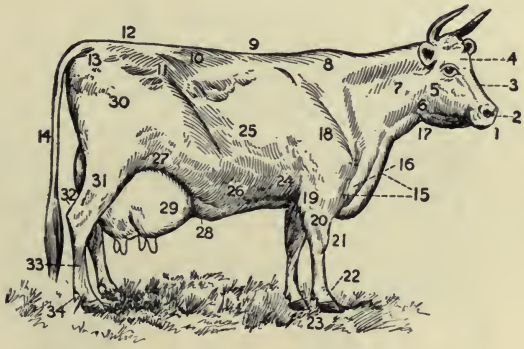


Fig. 33. — Diagram of cow. 1, muzzle; 2, nostrils; 3, face; 4, forehead; 5, cheek; 6, jaw; 7, neck; 8, withers; 9, back; 10, loin; 11, pinbone; 12, rump; 13, hips; 14, tail; 15, chest; 16, brisket; 17, throat; 18, shoulder; 19–20, forearm; 21, knee; 22, pastern; 23, foot; 24, chest; 25, ribs; 26, belly; 27, flank; 28, milk veins; 29, udder; 30, quarters; 31, thigh; 32, escutcheon; 33, cannon; 34, fetlock.

Make an outline drawing of the cow.

Exercise V

Object. To learn the breeds of sheep.

Method. Find in the animal husbandry book in the library how many different breeds of sheep there are. Ask a farmer how many breeds are to be found in the community. Can you see any difference in the breed that is kept for mutton and the one that is kept for wool? Make in your notebook a record of all the points of difference that you can find. Use the picture to name the parts.

Exercise VI

Object. To learn the parts of the sheep.

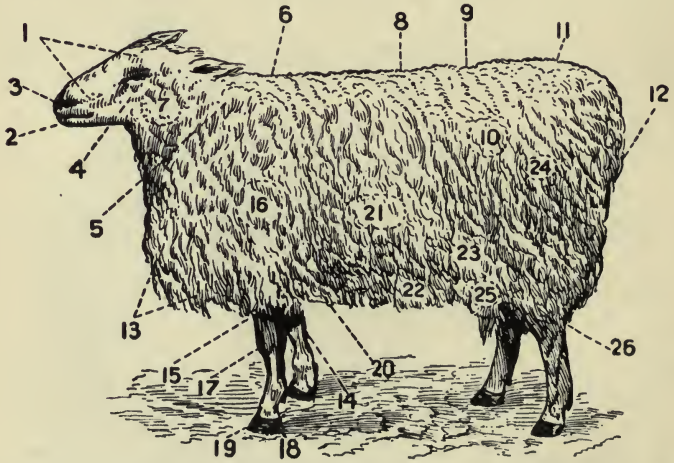


Fig. 34. — Diagram of sheep. 1, face; 2, muzzle; 3, nostrils; 4, eye; 5, neck; 6, top of shoulder; 7, cheek; 8, back; 9, loin; 10, twist; 11, rump; 12, dock; 13, brisket; 14, cannon; 15, foreleg; 16, shoulder; 17, knee; 18, foot; 19, toe; 20, foreflank; 21, ribs; 22, belly; 23, flank; 24, hip; 26, leg.

Method. From the illustration learn the names of the parts and where they are located. Have a sheep brought to school or visit the neighbor's flock. He will tell you which one is gentle and you can locate the parts on it.

Look at the wool and see if it is oily.

Make a simple drawing of the sheep. Sketch in the parts. Name the parts.

Exercise VII

Object. To learn the different breeds of hogs.

Method. Find out how many breeds of hogs there are in the community. Remember that the general types are the bacon and the lard types. Look in the animal husbandry book for the names of the different breeds. Study the points mentioned on each breed. Compare the points.

Which is your favorite breed? Why? Are hogs in your section a paying investment? Do you find any place where the hogs run with the cattle and are not given any extra feed? Would it be cheaper to raise them this way?

Exercise VIII

Object. To learn the parts of the hog.

Method. What breeds of hogs can you name? Which ones make good bacon and which ones make good lard? Would you then call them lard and bacon

types of hogs? Are they all the same color? Locate the parts on the illustration. Observe a hog carefully. Can you locate the parts from looking at the hog? Make a simple outline drawing of the hog. Sketch in the parts.

Which parts of the hog are worth the most money? How can the farmer get better hogs?

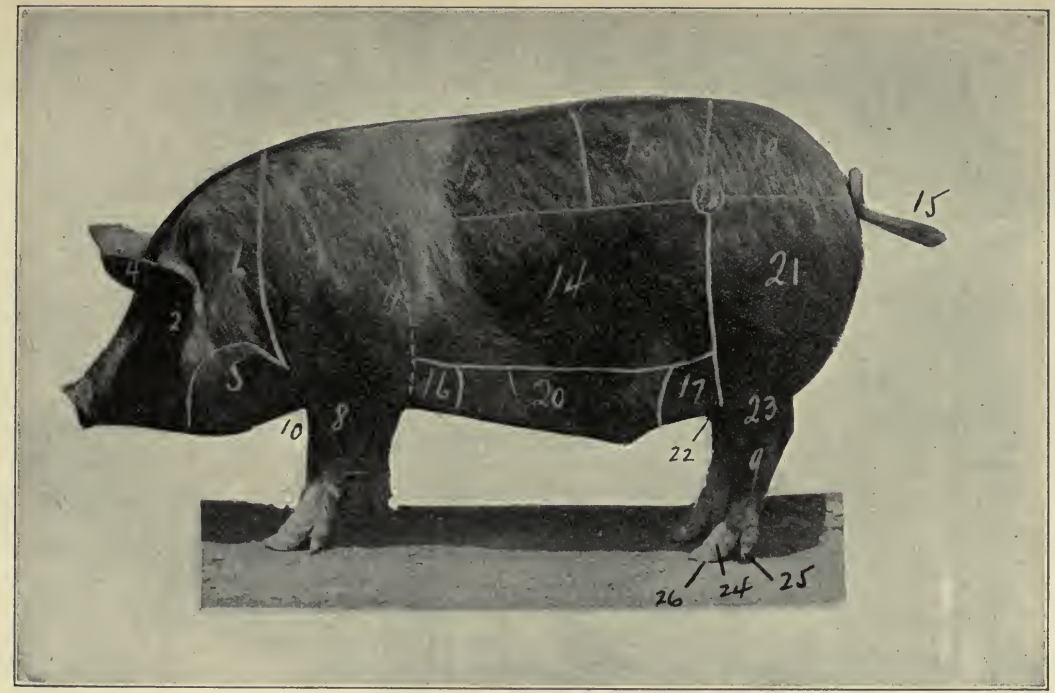


FIG. 21. — A fat hog, showing location of parts

1. Snout	5. Jowl	9. Hind leg	13. Loin	17. Hind flank	21. Ham	24. Pasterns
2. Eye	6. Neck	10. Breast	14. Side	18. Hips	22. Stifle	25. Dewclaw
3. Face	7. Shoulder	11. Chest line	15. Tail	19. Rump	23. Hock	26. Foot
4. Ear	8. Fore leg	12. Back	16. Fore flank	20. Belly		

POULTRY

Exercise I

Object. To learn the breeds of poultry.

Method. How many breeds of poultry have you seen in the neighborhood? There are two types of chickens, one for the eggs and the other for the meat. Which do you like the better? Would you like the breeds that lay well and are large enough to make plenty of meat?

What breeds are most numerous in your community? What kind would you keep?

Make a list of all the breeds, telling the best points about each. Compare the breeds as to size and color. Does it pay to keep chickens? What is the best number to keep?

Notice the points of difference. Are the combs the same size?

What kinds do you think lay the most eggs? What kinds make the best meat?

What kind would you keep? Why are they the best?

Exercise II

Object. To learn the parts of the chicken.

Method. Learn from the illustration to locate the different parts on the chicken. Make an outline draw-

1, Comb.
2, Beak.
3, Wattles.
4, Lobes.
5, Neck.
6, Body and Fluff.
7, Back.
8–9, Tail Coverts.
10, Tail Primaries.
11, Tail Fluff.
12–13, Wing Coverts.
14, Wing Primaries.
15, Breast.
16, Thigh.
17, Heel.
18, Tarsus.
19, Spur.
20, Toes.

FIG. 36. — Diagram of chicken.

ing of the chicken. Sketch in the parts. Bring to school a chicken. Locate the parts.

INSECTS

Exercise I

Make a collection of insects. An insect case can be secured from any agricultural supply firm, a store that handles laboratory supplies. A case may be made

Fig. 37. — A boy's collection.

from a pasteboard box. Place a glass cover over it. Paste tape over the edges and the corners. Use cotton in the back of the box. Place a moth ball in the box to keep the insects from being destroyed.

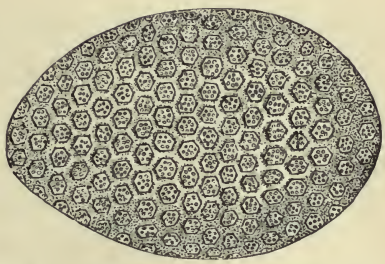


FIG. 38. — Insect's eggs, showing how many may be hatched at a time. (Magnified.)

EXERCISE II

Object. To learn something of the life and habits of the grasshopper.

Method. Collect a few grasshoppers, the largest that you can find. Put them under an inverted glass tumbler or other larger glass cover. Put some grass under the tumbler for them to eat. Raise one edge of the glass slightly to permit air to enter freely.

Watch these grasshoppers eat. Are grasshoppers "chewing" or "sucking" insects? This can be told by the way they get their food.

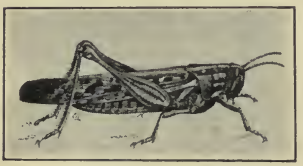


FIG. 39. — The grasshopper.

Where are grasshoppers found? What are their food plants?

Sometimes grasshoppers become so numerous that they destroy crops of grain. These insects are very hard to destroy. Will birds and chickens eat them? What

enemies has the grasshopper? How does it get away from its enemies? Are grasshoppers more plentiful some years than others?

How would you destroy grasshoppers? Would it be possible to cover whole fields with poison to kill grasshoppers? If one did, he might poison cattle and chickens. But grasshoppers lay their eggs in the ground in places where it is bare. Then how can we destroy the eggs?

The eggs of the grasshopper, unlike the eggs of many other insects, hatch, and small grasshoppers appear. They look almost exactly like the larger ones except that they are smaller and have very short wings.

Watch the grasshopper in the fields, its methods of locomotion and protective odor. Listen to its noise. Note where it stays and on what it lives. Catch a live specimen and try to find the breathing spiracle, just above the base of the middle legs. Watch the opening and closing of the lips of this breathing pore. Perhaps it will spit "juice" on you. Why does it do this?

Put your grasshopper in a glass, close the top with another glass inverted, and see if it will eat grass or leaves which you give it.

In what way do the hind pair of legs differ from the others? Of what advantage are the hooks and spines on the legs? Count the number of joints. How many times the length of its body can a grasshopper jump?

Read Circular No. 84, U. S. Department of Agriculture, Bureau of Entomology.

Exercise III

Object. To learn about the Ladybird.

Method. Secure a few specimens of the Ladybird. Look through the orchard and the other trees and see where you will find the most of them. Make a drawing of one of the larvæ and of one of the adult ladybirds.

Can you think why it is called a beetle instead of a bug?

It should not be killed, for there is not another insect that is so beneficial. It eats the dreaded San José scales and other scales. It should be studied so that we will know better than to kill it when we see it.

Write to your experiment station or to the Secretary of Agriculture, Washington, D.C., for a bulletin of the life history of the ladybird.

Exercise IV

Object. To learn something of the life and habits of the house fly.

Method. Let us see where the house fly comes from. The stages in the life of the house fly are much like those of other insects. Flies lay their eggs in manure, decaying flesh, and filth. The eggs hatch, and the little " maggots " correspond to the larvæ of the butterfly. The " maggot " spends a short time in a little case and comes out a full-grown fly.

Put a live fly under an inverted glass tumbler and

watch it walk. How does it stick to the sides of the glass?

The fly can easily pick up dirt and disease germs on its sticky feet and carry them away with it. Have you heard the house fly called the "typhoid fly"? Can you see any reason for this name? Flies are the worst carriers in the spread of typhoid fever.

FIG. 40. — The house fly.

When you find house flies on filth of any kind, sprinkle some fine flour or lime on them so you can tell them from other flies. Do you see any of the same flies on the dinner table? Do you suppose they have washed their feet? Where should one commence to destroy flies? How can we keep them out of our houses?

We can destroy the breeding places of flies by removing all decaying organic matter, or covering it with screens. Waste material may be treated with kerosene. It kills the maggots. Kitchen waste can be placed in large cans, covered, and hauled away. Flies can be kept out of houses by using screen doors and windows.

Read Farmers' Bulletin No. 155, U. S. Department of Agriculture.

EXERCISE V

Object. To study the dragon fly.

Method. Look on a pond or running stream for a fly that looks like the one in the picture. It may be

one that has lighted for a moment on the flowers near by. These flies are easily caught with a net.

After looking at them and catching one notice the way they fly. Do you think that the wings will wear out?

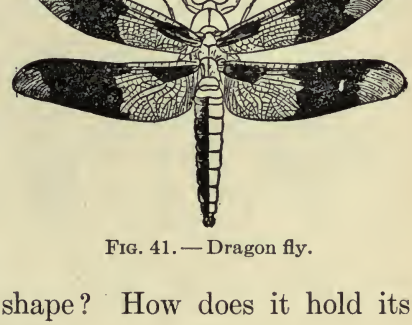


Fig. 41. — Dragon fly.

What is their food?

How does the dragon fly differ from the other flies in size and shape? How does it hold its wings while it is not flying?

Make a drawing of the specimen that is brought to the class.

Exercise VI

Object. To study the honeybee.

Method. Cover a honeybee with a drinking glass fixed so that the bee can get air freely. Examine it. Look at the pockets on the hind legs with a magnifying glass.

Leave the bee under the glass for a day. Then put a bee in with it, and if they are from the same hive, watch the last bee feed the hungry bee.

Notice the size of the body as compared with the wings. Would its wings be easily worn out?

Examine a piece of the honeycomb and see if you can tell why it is six sided.

What kind of flowers do the bees feed upon? Will it sting you while it is feeding? Does it stay long upon one flower? Does it stay upon the same kind of flowers each trip? What does it gather from the flowers?

Worker. Drone. Queen.

FIG. 42. — The bee.

Are honeybees useful to the farmer? Why? What difference can you see between the honey and the humble bee?

Make a sketch of the honeybee.

EXERCISE VII

Object. To study the mosquito.

Method. Get some mosquito eggs from a barrel of water left standing for many days or from the shallow water of a pond.

Watch the eggs hatch and develop the same as you did the house fly. Make a drawing of them in the different stages. Watch them bite a piece of meat.

How is the mosquito fitted for carrying diseases? Should the mosquitoes be destroyed? Why?

Write to the Secretary of Agriculture, Washington, D.C., for the bulletin on the mosquito.

Exercise VIII

Object. To study the beetle.

Method. Bring to the class as many kinds of beetles as you can find. Make a drawing of the common beetles. Make a drawing of the beetle with the wings spread out.

Fig. 43. — Ground beetle. *a*, larva; *b*, adult.

How many wings has the beetle? What is found over the wings? Can you think of a reason for it being there? Do the wings need to be protected? How many joints in the beetle's leg?

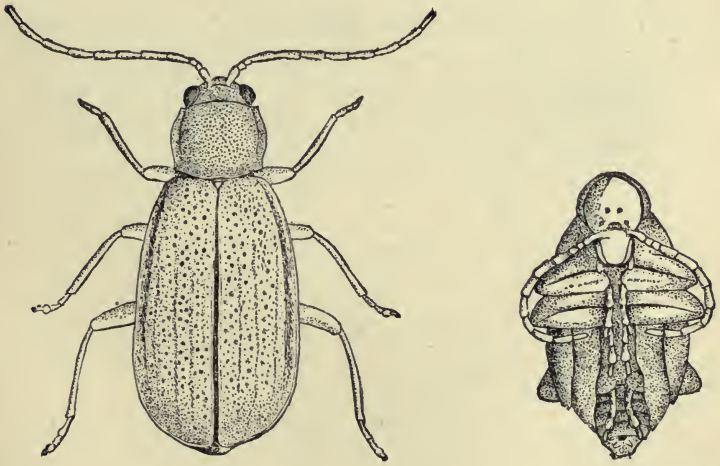


Fig. 44. — Long-horned beetle. *a*, front view; *b*, back view.

Are the mouth parts made for biting or sucking? How can one tell?

How do you think that beetles live? Do you think that they do good or harm?

An insect with a hard shell is called a beetle.

Exercise IX

Object. To learn of the life and habits of moths and butterflies.

Method. The Tiger moth, or "Woolly bear," as it is often called, is one of our most common moths. The larva is covered with stiff hairs. At either end

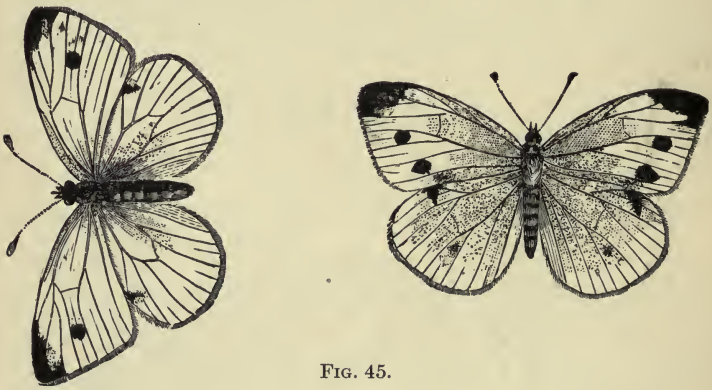


Fig. 45.

of the larva the hairs are black. In the middle of the body the hair is reddish brown.

Observe these larvæ in the autumn and in the early spring as they go hurrying along. Can you tell where they are going? Do they stop to eat? Put a few of

them in a jar and cover it with cheesecloth. Put in some grass for them to eat. Do they eat the grass?

Notice how they spend the seasons. In the spring they make a case for themselves out of their own hairs, and after a very short time in the case they come out an adult moth of a dull yellow color with a few black spots on the wings. The larvæ of these moths destroy a great many plants. The plants upon which they feed are so plentiful that the injury from moths and butterflies is not noticed. Did you ever see a winged moth feeding?

Make a list of the cultivated plants that you have seen caterpillars eating.

In which stage of their lives are the moths most destructive — the larva or the adult?

What difference have you noticed between moths and butterflies? Compare their antennæ, general color, the way they hold their wings when at rest, and the time of the day when you have seen them. Can you see any way that the moths may be a benefit to the farmers?

If you have not a tiger moth, write to your state experiment station for one.

Read the life history of the moths in the natural science books that are in the school library.

Exercise X

Object. To learn whether butterflies and moths are of use to the farmer.

Method. Let us first learn something of the life of the butterfly and moth. A tiny egg that has been laid

FIG. 46. — The larva of black swallowtail butterfly. (Photo by M. V. Slingerland.)

by a butterfly or moth hatches into what we call a "worm." This is not a true worm because it has feet, and worms do not have feet. This is a caterpillar — one stage in the life of a butterfly or moth. The caterpillar is also called a larva. Some of these caterpillars become butterflies and some become moths, or millers, as they are also called.

FIG. 47. — Adult black swallowtail butterfly. (Photo by M. V. Slingerland.)

The caterpillar passes the next stage of its life shut up in a little case called a cocoon. If the caterpillar is to become a moth, it generally weaves a web of silk around itself. After some days it will come forth from its case a full-grown butterfly or moth.

The swallowtail is one of the common butterflies. The larvæ or caterpillars live on wild and cultivated parsnips and carrots, marsh parsley, etc. Professor Comstock describes the larva as a "green worm ringed with black and spotted with yellow."

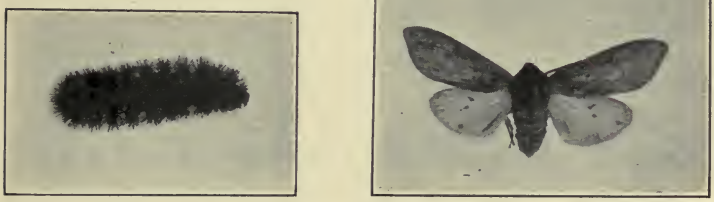


FIG. 48. — Larva of moth. Adult.

Place several larvæ in a jar; put in the jar for them to eat some of the plant on which you found the caterpillar. Cover the jar with a piece of cheesecloth. Notice a leaf very closely after a caterpillar has been eating it. Notice it an hour later and see how much has been eaten. How long would it take a dozen of these caterpillars to eat a whole plant?

How may the larvæ of butterflies benefit the farmer? After the weeds are all killed what may the cater-

pillars eat? The larvæ of some butterflies live almost entirely on cultivated plants.

Birds eat some moths and butterflies and their larvæ, but they will not eat the larvæ of the swallowtail butterfly. Can you tell why? Touch a larva and observe the sickening odor.

The adult butterfly eats almost nothing and does practically no harm. The larvæ are often very destructive. Birds and other natural enemies keep in control some destructive insects, but others have very offensive odors. The swallowtail butterfly has such a disagreeable odor that birds will not bother it.

Other caterpillars may be studied in this way.

Exercise XI

Object. To learn how to destroy common insects.

Method. Observe plants that have insects working on them. Do the insects appear full grown? Larvæ and adult insects may both be working on the plants at the same time. How are the insects injuring the plants? Do they eat the leaves or do they injure the plant in some other way? Look over a pumpkin or melon vine and see whether you can find any insects on the ground around the vines or under the leaves. Have the insects eaten the leaves?

Have you observed insects that suck the juices of plants and weaken or kill them? Do these insects eat the leaves? To kill "sucking insects" one must put

something directly on the insects. There are also insects that eat the leaves of plants. To kill these "chewing insects" a poison can be put on the leaves, so that when the insects eat the leaves, they will eat the poison also.

What should one know about insects before he tries to kill them?

How can you kill grasshoppers? Cabbage "worms"? Plant lice? Potato beetles?

Do not forget that arsenate of lead and Paris green are poison when eaten. The lime-sulphur mixture is poison to those that suck.

Have you noticed any crop that has been destroyed by insects? Could these insects have been controlled by spraying?

Write to your state experiment station and ask for a copy of their bulletin on "Insect Control."

BACTERIA

Exercise I

Object. To show the effect of unclean dishes on the souring of milk.

Method. Pour some milk into two dishes or pans and let it sour. Empty both pans. Wash one with hot water. Do not wash the other. Now put some sweet milk into both dishes and let it stand. Which one sours first? Why?

Empty the dishes again, washing again in hot water the one that was washed before. Now put some milk into each dish once more and see how much quicker it sours this time than it did before in the one that was not well washed.

Should milk cans be washed in boiling hot water often? Daily?

What is the best means of keeping milk from turning sour quickly?

Exercise II

Object. To find out why foods spoil.

Method. Place two small pieces of stale bread on a plate. Moisten one piece. Keep the other dry. Turn a glass tumbler over each and keep them about the

temperature of an ordinary room. Keep them away from sunlight. Leave them until a dark mold forms. On which did the mold begin to form first?

If you were going to keep bread for several days, would you keep it dry or moist? Why?

Observe the mold as it grows on the side of the glass. Make a drawing to show the little fibers of the mold.

Where does the mold come from? On what things have you seen mold growing? Why will it not grow on everything? Leave the mold to grow for several days on the bread. What happens to the bread?

Mold is one of the many very small plants that causes the decay of whatever it grows upon. Like other plants it must have food, moisture, and a certain amount of warmth to grow. Spores from which mold grows are often blown about in the air and may settle in any place. Do you think that one piece of bread that was moldy would cause the other pieces around it to get moldy?

THE TOAD

Exercise I

Object. To learn something of the habits and usefulness of toads.

Method. Every one is familiar with our common toad.

Fig. 49. — The toad after a hard winter.

Where have you seen toads? In what kinds of places do you find toads in the daytime? At night? Do you see them in the hot part of the day? Where do they spend the winter?

Have you ever seen toads eating anything? What is their food? Do they kill their food before eating it? Watch them eat.

Toads live almost entirely upon insects. Many of these insects come out in the evening after remaining hidden during the day.

Have you ever seen a toad under a light at night? Why would you expect to find toads about lights at night? Did you ever see a dog take a toad in his mouth? Why not?

Toads are valuable farm property. A few of them in a garden are often worth a great deal as destroyers of destructive insects. Toads should be encouraged to live in gardens and in yards where flowers are grown. Give as many reasons as you can why the farmer should not kill any toads that are found on his place.

Read Farmers' Bulletin No. 196, U. S. Department of Agriculture.

THE RABBIT

Exercise I

Object. To determine whether the cottontail rabbit should be protected.

Method. Some farmers say that rabbits eat much grass; others say that these rabbits destroy much cabbage and still others say that they destroy many small trees, especially in winter when deep snows cover the ground. There is another class of farmers who say that rabbits rarely destroy anything; that they are pretty and every one delights to see them playing around the farmstead in the evening; that they are always ready to be chased by a dog, and who does not enjoy a rabbit chase? They furnish good sport for the hunter, and their fur and meat have some value.

Have a live rabbit brought to school. Notice the protective color. Why do they have such large ears? Observe the pads on the bottoms of their feet. Of what uses are these pads?

Where do rabbits live? Can you tell which way a rabbit travels from its tracks in the snow? What is their food? When do rabbits hunt their food? Where

do rabbits stay in the daytime? Have you ever seen the nest of a rabbit?

What enemies has the rabbit? Do you think that the "game law" should apply to rabbits as well as squirrels?

BIRDS

Exercise I

Object. To learn something of the value and habits of birds.

Method. Observe the birds in a pasture, field, or meadow in the spring or fall. Among the birds that one may see is the meadow lark. This bird is about ten inches long; its back is gray with small black spots on its sides, and it has a yellow breast with a black line under the yellow throat.

Fig. 50. — Maryland yellow-throat.

The meadow lark may be known by its sailing and by the white feathers shown in its tail when it flies. Its clear, flutelike whistle is heard while it sits on a tree top or fence post. It sings as though it were entertaining an audience. The meadow lark may often be seen walking around on the ground.

What is likely to be the food of birds that spend much of their time on the ground? Many birds live almost entirely on destructive insects and weed seeds. Is the meadow lark one of these?

FIG. 51. — A young meadow lark.

Compare the meadow lark to the flicker as to size, color, and habits. What other birds are much like the meadow lark? In what ways are they alike?

Have you ever seen a meadow lark in the woods?

Observe where they are when singing? Where do they spend the winter?

Their nest is built of grass on the ground and generally almost hidden by the grass. Try to find a nest.

FIG. 52. — A robin, the farmer's friend.

The birds are our best friends. What can we do to become their friends?

Read Farmers' Bulletin No. 54, U. S. Department of Agriculture, Washington, D.C. See Audubon Educational Leaflet No. 3.

EXCURSIONS

Exercise I

Object. To study the things that are around us.

Method. Walk into the fields to see things. Ask the class before starting some of the things that they are likely to see. Give instructions before starting and tell how the report is to be written in the notebook.

Study the pasture field. Can you see another pasture that is better? One that is not so good? Why is one pasture better than the other? Study two fields of corn. Which will grow the more bushels of corn to the acre? Why? Study and compare all the important crops and bring out the reasons why some crops are so much better than others. When in doubt about the answers, discuss the questions with the farmers. They will be glad to answer your questions, when they see that you are trying to help yourself.

Look at the trees and notice the difference between the shape of those that grow in the woods and those that grow in the open fields. Can you give a reason for this difference? Collect leaves from as many different kinds of trees as you can find. Learn the names of the trees from the bark and the leaves. Make a list of all the trees that you found and give two uses of the lumber made from each kind of tree.

Notice the fences and see if the new ones are built of the same kind of material that the old ones are.

Observe the rocks. Do you see any plants growing on them? The circular irregular plants are called lichens. Look up in the dictionary the pronunciation of the word. Can you tell why they grow upon the rocks? Where do they get their food?

Tell about the other things that you have seen that are interesting.

Several trips of this kind may be taken. Fifteen to twenty minutes is long enough to spend on each trip. It is advisable to have a good observer go over the ground first to see what the important features are and what is to be seen.

Exercise II

Object. To study the farm, in detail.

Procedure. Make a drawing of the farm, locating the fences, springs, etc. Give as nearly as possible the number of acres in each field.

Answer the following questions in your notebook.

1. Kind of farming done.

Grain	Truck
Live stock	Fruit
Dairying	General farming

2. Surface condition: hilly — level.
3. General condition of the soil: fertile — poor.

4. Water supply, amount drained.

5. What are the advantages or the disadvantages of the location: school — market — church — neighbors?

6. Improvements: house — farm buildings — fences.

7. Has the yard been beautified?

8. Climate and healthfulness.

Make a list of all the weeds that you have seen on the farm.

Make a list of all the useful plants that grow on the place.

Make a list of all the wild animals that you have seen.

Make a list of all the birds that you have seen.

Make a list of all the insects that you have seen.

Add to this list as you see things that are new.

Report in the class when you see anything worth mentioning.

Exercise III

Object. To get a clear idea of the size of a piece of land. The school plot.

Method. Measure the length and width of the school plot. If possible, make a drawing to a suitable scale of the plot. If corn is planted in rows three feet five inches apart, how many rows running lengthwise can there be in the school lot? Measure and verify the answer.

Allow six feet space not to be plowed along the fence.

Measure the length of the row and find out the number of hills in a row if the hills are also three feet five inches apart.

How many hills in the school ground? Since there is 43,560 square feet in an acre, what part of an acre is in the school grounds?

Exercise IV

Object. To learn something of the destruction of forests.

Method. Take a walk out into a near-by woodland. Look on trees, stumps, and logs for large white shelf- or bracket-like growths. These have been called "toad stools," bracket fungus, and shelf fungus.

Do these bracket fungi grow on dead wood or live wood? If any are found on growing trees, do the trees look healthy and vigorous or are they decaying? Look carefully and see if you can find a wound where the fungus grows, if found growing on a live tree. What is the color of the fungus on top? Underneath? Cut down through the fungus and notice the layers. You can tell how old it is from the layers. What do you think that the fungus feeds upon? Since this fungus destroys many forest trees and even sawed lumber, what class of men are likely to be most interested in it?

Forest trees are destroyed by forest fires, insects, and fungus growths. The lumber industry is one of

the important industries where there are forests. The work of the fungi is not noticed so much as the other causes of the destruction of the forests, but it is slowly destroying timber. The fungus feeds upon decaying wood. When a tree shows signs of weakness, fungus is always ready to attack it.

STUDY AND DISCUSSION

Exercise I

Object. To learn why there are different kind of farming in different parts of the country.

Method. In your geography look at the list of agricultural products in Texas, Alabama, California, New York, Illinois, and Michigan. In what states do you find cotton? What kind of climate does it take to grow cotton? In which states do you find oranges? What kind of climate have those states? What states raise fruit? Why?

From your map pick out the most mountainous states and the levelest ones. Now look at their products. Are the same products raised in all these states?

In which states do the products require the most cultivation?

Why are milk, strawberries, and hay produced close to market? Does it take more work to raise an acre of hay or an acre of potatoes? If the soil is suitable to raising either hay or potatoes, which will a farmer grow when labor is plentiful? Will he follow gardening if he is not close to a city?

Can you tell why it would be desirable to fatten

cattle in Illinois? Which one of the states grows the most wheat? Why?

What crop is grown more than any other in your community? Can you give any reasons for this crop being so much raised?

What things do you now think of growing?

Exercise II

Object. To learn where beef can be produced cheaply.

Method. Since beef can be produced wherever corn and grass grow, let us see where corn and grass can be grown cheaply. The census report, 1910, gives the following figures:

	Iowa	New York	Virginia
Yield of corn per acre .	37.1 bu.	35.4 bu.	20.6 bu.
Value of corn per acre .	$18.16	$22.32	$15.53
Yield of hay per acre .	1.5 T.	1.4 T.	1.06 T.
Value of hay per acre .	$11.76	$15.34	$13.26

In which of the three states is corn the cheapest? Hay?

If it takes the same amount of labor and feed to grow cattle in each of the three states and pasture is the same price, in which one can they be grown the cheapest?

If it takes ten pounds of hay and ten pounds of corn to produce one pound of beef, how many pounds of

each will it take to produce 1000 pounds of beef? How much will it cost to produce 1000 pounds of beef in Iowa? In New York?

If it costs 75 cents per hundred pounds to market the beef grown in Iowa, and 20 cents per hundred pounds to market that grown in New York, in which state can the farmer make the greater profit growing beef cattle? Which do you think would pay the farmer best, to market his corn and hay or feed them to cattle and market the cattle? What kind of farming would you call it when the cattle are sold instead of the grain?

Exercise III

Object. To determine how many domestic animals to keep on a farm.

Method. What different kinds of animals do you see on the farms? Why do some farmers keep cattle and others keep sheep? Is the pasture all alike?

Why do farmers need animals on their farms? Every farmer who grows crops has some cheap feed to sell or use; he also needs some stable manure for his farm. A great many successful farmers keep about one cow or one horse for each five acres of crops grown.

If a farmer grows thirty acres of crops on a fifty-acre farm and keeps three horses, how many cows can he keep? If a farmer grows ninety-five acres of crops on a 175-acre farm and keeps four horses, how many cows can he keep?

On this same farm, suppose the farmer keeps four horses and six cows, how many sheep could he keep if six sheep eat as much as one cow?

Exercise IV

Object. To find out how much money a farmer has to live on.

Method. A farmer living in New York has $25,750 invested in his farm, machinery, live stock, and buildings. This is his capital.

He received during the year from the sale of crops $1813, animals $154, milk and eggs $3045, and maple sirup $88. During the year he paid for stock $450, for labor, feed, fertilizer, taxes, new machinery, etc., $2326. How much more money has he received than he paid out? He should have this amount on hand at the end of the year.

If his capital had been invested in some other business, it should have made him 5 per cent interest. How much is the interest on his capital at 5 per cent? If you subtract this from the amount he has on hand at the end of the year, how much has he left?

If there are five persons in the family, how much will each one have to live on? Do you think they can live on this amount? How much of this could you save after spending all the money necessary for your expenses, allowing a reasonable amount for pleasures?

Exercise V

Object. To determine why some farms are more profitable than others.

Method. Let us look at the receipts and expenses of two common farms located in the same neighborhood in one of the Middle States.

The first farm contains 60 acres and is valued at $12,092. The farmer keeps one hired man almost the whole year, eight horses, three cows, and does general farming. His receipts for the year were:

For milk and butter	$720	For hay	$ 75
For calves	80	For labor and other receipts	528
For potatoes	18		
For cabbages	205		

His expenses for the year were $1040. How much did he receive for his labor and the use of his farm for the year?

The second farm contains 226 acres and is valued at $25,750. The farmer keeps two hired men all the year, six horses, twenty-eight cows, and does general farming. His receipts for the year were:

For milk	$2520	For millet	$ 75
For calves	270	For other things	288
For potatoes	163		
For cabbages	1650		

His expenses for the year were $2650. How much did he receive for his labor and the use of his farm for the year?

What is the one reason why one man made more money than the other? Are the farmers with small or large farms in your community making the greater profits? Any business must be large if labor and machinery are used to the best advantage.

Exercise VI

Object. To learn something of the building of good roads.

Method. In the dictionary look for the meaning of the words "Macadamize" and "pavement." Are

Fig. 53. — A scene along Tug River showing part of the road in the distance complete with Macadam.

there any roads near by that are "Macadam roads"? Concrete roads? What kinds of roads are these?

Why are the roads (streets) in towns better than

those in the country? Of what materials have you seen roads and streets built?

One state has appropriated $100,000,000 for building state roads. This money is being used in building Macadam roads. How many miles of road will this build if it costs $4000 to build a mile?

FIG. 54. — A good view of Macadam road, showing old road at the left.

Are roads getting better or worse as the number of automobiles increase? What should be done with automobile license money?

How would good roads improve farm conditions in the winter time? How much more can you haul over good roads than you can over poor ones? Then why will good roads save dollars as well as time?

Read Farmers' Bulletin No. 338, U. S. Department of Agriculture.

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